NAME ______________________ CLASS ____________ DATE ____________

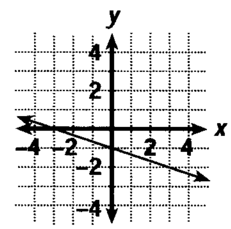
Reteaching
5.2 Defining Slope

◆**Skill A** Finding the slope of a line from its graph

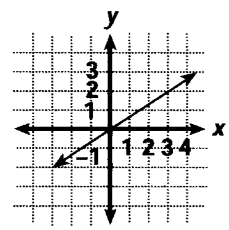
Recall Slope is the ratio of vertical change to horizontal change between two points on a line. A line that slants upward from left to right has a positive slope. A line that slants downward from left to right has a negative slope. A horizontal line has a slope of zero. The slope of a vertical line is undefined.

◆ **Example 1**
Tell whether the slope of the line is positive or negative.

◆ **Solution**
Because the line slants downward from left to right, the slope is negative.



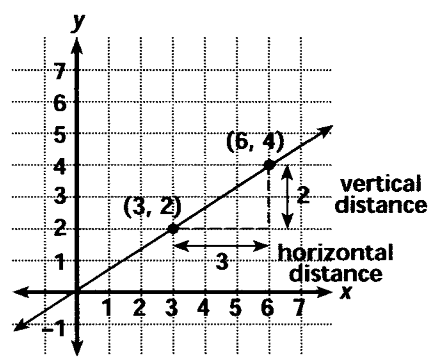
◆ **Example 2**
Find the slope of the line shown at the right.



◆ **Solution**
Choose two points that are on the line and whose coordinates are integers. Draw a line from one point to the other. Find the horizontal distance and the vertical distance by counting the boxes. Form the ratio of vertical distance to horizontal distance. Determine whether the slope is positive or negative.

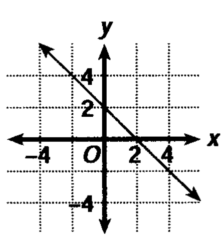
$$\text{slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} = \frac{2}{3}$$

The line slants upward from left to right, so the slope is $+\frac{2}{3}$.



Tell whether the slope of each line is positive, negative, zero, or undefined.

1.



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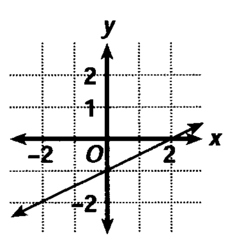
2.



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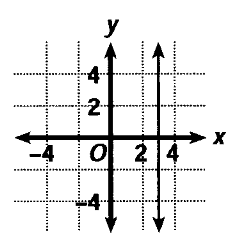
3.



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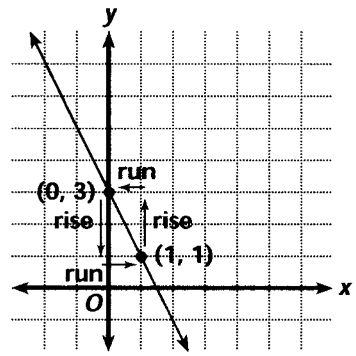
NAME ______________________ CLASS ____________ DATE ____________

◆ Skill B Calculating the slope of a line

Recall slope $= \frac{\text{rise}}{\text{run}} = \frac{\text{difference in } y\text{-coordinates}}{\text{difference in } x\text{-coordinates}}$

◆ **Example 1**

Find the slope of the line by using the graph.



◆ **Solution**

1. Locate two points whose coordinates are on the line and are easy to read.
   (0, 3) and (1, 1)

2. Find the rise and the run as you go from one point to the other. The starting point does not matter.

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{1-3}{1-0} = \frac{-2}{1} = -2$$

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{3-1}{0-1} = \frac{2}{-1} = -2$$

◆ **Example 2**

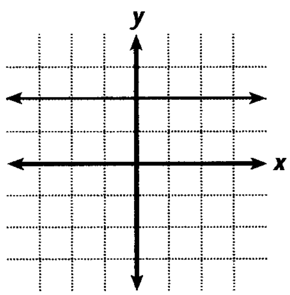
If the points $A(-1, 4)$ and $B(3, -2)$ are on a line, what is the slope of the line?

◆ **Solution**

$$\text{slope} = \frac{\text{difference in } y\text{-coordinates}}{\text{difference in } x\text{-coordinates}} = \frac{4-(-2)}{-1-3} = \frac{4+2}{-4} = -\frac{6}{4} = -\frac{3}{2}$$

Find the slope of each line by using the graph.

4.



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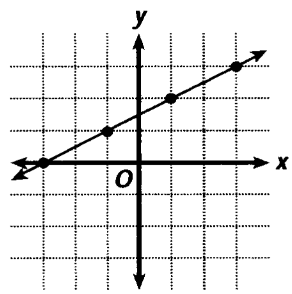
5.



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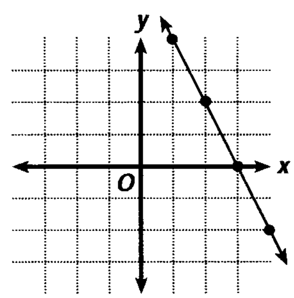
6.



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Find the slope of the line that contains each pair of points.

7. (1, 1), (4, 4) ________ **8.** (0, 1), (1, 0) ________ **9.** (−3, −1), (0, 5) ________

10. (2, 3), (−2, 1) ________ **11.** (−3, −2), (2, 1) ________ **12.** (−3, 3), (4, −1) ________

NAME ______________________ CLASS ____________ DATE ____________

Reteaching

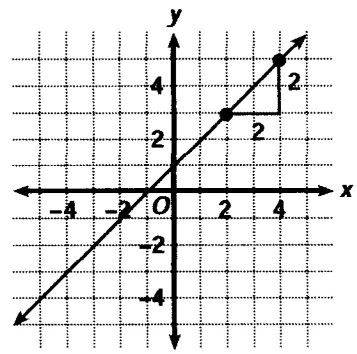
5.3 Rate of Change and Direct Variation

◆ **Skill A** Finding the rate of change of a linear function by using a graph

Recall The rate of change of a linear function is the same as the slope of the graph of a linear function.

◆ **Example 1**

Find the rate of change in the linear function graphed at right.



◆ **Solution**

The rate of change or slope is

$$\frac{\text{change in the } y\text{-coordinates}}{\text{corresponding change in the } x\text{-coordinates}}$$

rate of change: $= \frac{5-3}{4-2} = \frac{2}{2} = 1$

Recall When you know the coordinates of two points on a line, the slope of the graph of the linear function is given as follows:

$$\frac{\text{difference in the } y\text{-coordinates}}{\text{corresponding difference in the } x\text{-coordinates}}$$

◆ **Example 2**

Find the rate of change in the linear function whose graph contains (3, 1) and (5, 2).

◆ **Solution**

rate of change: $\frac{2-1}{5-3} = \frac{1}{2}$

Find the rate of change of the linear function containing each pair of points.

1. (5, 3) and (8, 7) ____________

2. (0, 5) and (−3, 4) ____________

3. (4, 9) and (2, 5) ____________

4. (−6, −6) and (4, 2) ____________

5. (8, 6) and (−3, 6) ____________

6. (7, 2) and (2, −7) ____________

7. (−3, −8) and (−1, −5) ____________

8. (9, −4) and (9, 4) ____________

9. Write the expression *8 out of 10 students study at least 2 hours a day* as a rate of change. ____________

NAME ______________________ CLASS __________ DATE __________

◆ Skill B Solving direct-variation problems by using a table

Recall In the equation $y = mx$, m is the slope of the graph of the equation.
When $y = mx$ and $m \neq 0$, then y varies directly as x.
The value of m is called the constant of variation.
If $m > 0$, then as x increases, y increases.
If $m < 0$, then as x increases, y decreases.

◆ **Example 1**

Suppose that y varies directly as x and $y = 3x$.

a. Find the constant of variation.

b. What is the value of y when $x = 9$?

◆ **Solution**

a. The slope of $y = 3x$ is 3, so the constant of variation is 3.

b. When $x = 9$, $y = 3(9)$, or 27.

◆ **Example 2**

Jill works as a cable technician and charges by the hour. Her records show the hours worked and the salary that she receives for various jobs.

Hours	3	5	7	10	15
Salary	$135	$225	$315	$450	$675

Find the constant of variation and write the direct-variation equation.

◆ **Solution**

The ratio of Jill's salary to hours worked is constant.

$$\frac{135}{3} = \frac{225}{5} = \frac{315}{7} = \frac{450}{10} = \frac{675}{15}$$

Let x represent hours worked, and let y represent dollars earned.

Then $\frac{y}{x} = \frac{135}{3}$, or $\frac{y}{x} = 45$. Thus, 45 is the constant of variation, and $y = 45x$.

For each direct variation, find the constant of variation and an equation. Then complete the table.

10.

x	2	5	9	12	15
y	$13	$32.50	$58.50		

____

11.

x		56	77	112	140
y	3	8	11	16	

____

NAME ______________________ CLASS ____________ DATE ____________

Reteaching

5.4 The Slope-Intercept Form

◆ **Skill A** Writing an equation of a line in slope-intercept form

Recall The slope-intercept form of a line is $y = \underset{\substack{\uparrow \\ \text{slope}}}{m}x + \underset{\substack{\uparrow \\ y\text{-intercept}}}{b}$.

◆ **Example**

Write an equation for each line.

a. containing (0, 1) and with a slope of −2

b. containing (3, −4) and (9, 0)

◆ **Solution**

a. The slope, *m*, is given as −2. The line contains (0, 1), so this point is the *y*-intercept, or *b* is 1. Substituting these numbers into the equation gives $y = -2x + 1$.

b. First find the slope. $m = \frac{-4 - 0}{3 - 9} = \frac{-4}{-6} = \frac{2}{3}$

Then subtitute the coordinates of one of the given points into the equation and solve for *b*.

For the point (9, 0): $0 = \frac{2}{3}(9) + b$

$0 = 6 + b$

$b = -6$

Substituting this number for *b* and $\frac{2}{3}$ for *m* into the equation $y = mx + b$ gives the equation $y = \frac{2}{3}x - 6$.

For each equation, find the slope and the *y*-intercept.

1. $y = 3x - 1$ ____________ **2.** $y = \frac{1}{2}x + 2$ ____________ **3.** $y = -x + \frac{1}{2}$ ____________

Write an equation in slope-intercept form for each line.

4. with a slope of 2 and a *y*-intercept of −1 ____________

5. containing (0, −3) and with a slope of $\frac{1}{3}$ ____________

Write an equation in slope-intercept form for the line that contains each pair of points.

6. (1, 1) and (3, 5) ____________ **7.** (2, −4) and (−1, 5) ____________

8. (2, 4) and (−4, 1) ____________ **9.** (1, 0) and (3, 2) ____________

NAME ______________________ CLASS __________ DATE __________

◆ Skill B Using the slope-intercept form to write equations of lines

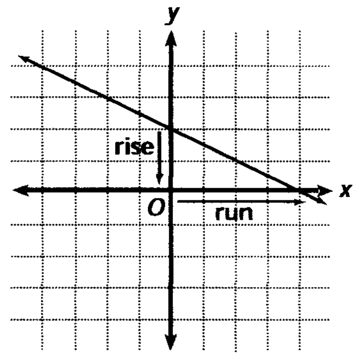
Recall In the formula $y = mx + b$, m is the slope and b is the y-intercept.

$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}}$

The y-intercept is the point where the line crosses the y-axis.

◆ **Example**

Find the equation for the graph.



◆ **Solution**

The line crosses the y-axis at (0, 2), so $b = 2$.

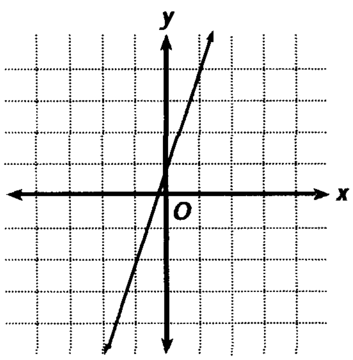
Locate two points on the line and count in order to find the slope.

$\text{slope} = \frac{\text{rise}}{\text{run}} = -\frac{2}{4} = -\frac{1}{2}$

The equation for the graph is $y = -\frac{1}{2}x + 2$.

Write an equation in slope-intercept form for each line graphed below.

10.



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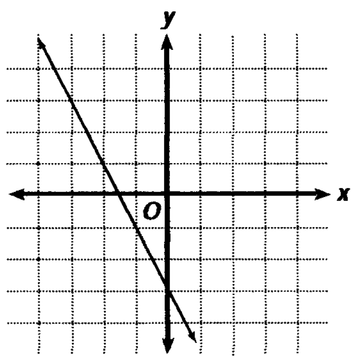
11.



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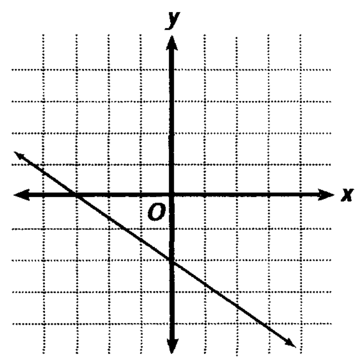
12.



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Adena charges \$5 plus \$3 an hour for babysitting.

13. Write an equation for the amount of money, y, that Adena can earn by babysitting for x hours. ______________________

14. How much will Adena earn if she babysits for 5 hours? ______________________

15. How many hours will Adena have to babysit in order to earn \$26? ______________________

NAME ________________ CLASS ________ DATE ________

Reteaching
5.5 The Standard and Point-Slope Forms

◆ **Skill A** Writing an equation of a line in standard form

Recall The standard form for the equation of a line is $Ax + By = C$, where A, B, and C are integers, A and B are not both zero, and A is not negative.

◆ **Example**
Write the equation $x = \frac{3}{4}y + 3$ in standard form. Then find the intercepts and use them to graph the equation.

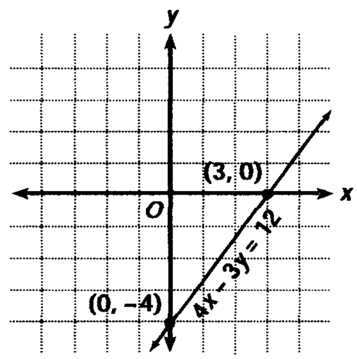
◆ **Solution**

$x = \frac{3}{4}y + 3$ Given
$4x = 3y + 12$ Multiply each side by 4.
$4x - 3y = 12$ Subtract $3y$ from each side.

To find the y-intercept, let $x = 0$.
$4x - 3y = 12$
$0 - 3y = 12$
$y = -4$

To find the x-intercept, let $y = 0$.
$4x - 3y = 12$
$4x - 0 = 12$
$x = 3$

Thus, the intercepts are $(0, -4)$ and $(3, 0)$.
Use your intercepts to graph the line.



Write each equation in standard form.

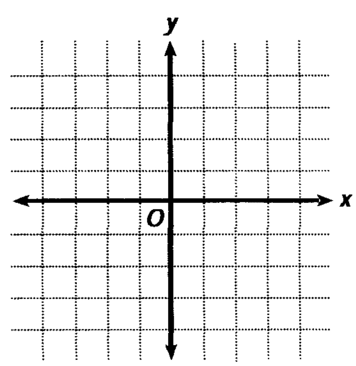
1. $5x = 10y + 15$ ________ **2.** $3y = 2x$ ________

3. $y = \frac{2}{5}x - 1$ ________ **4.** $3x - 5 = \frac{1}{2}y + 1$ ________

Find the x- and y-intercepts for the graph of each equation. Then graph both equations on the grid provided.

5. $2x + y = -2$ ________

6. $3x - 2y = 6$ ________



NAME ______________________ CLASS __________ DATE __________

◆ **Skill B** Writing an equation of a line in point-slope form

Recall The point-slope form for an equation of a line is $y - y_1 = m(x - x_1)$.

◆ **Example**

Write an equation for the line through $(1, -1)$ and $(-1, 5)$

a. in point-slope form.

b. in slope-intercept form.

◆ **Solution**

a. First find m.

$$m = \frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}} = \frac{-1 - 5}{1 - (-1)} = \frac{-6}{2} = -3$$

Substitute the slope and one of the points into the point-slope equation.

$y - y_1 = m(x - x_1)$

$y - (-1) = -3(x - 1)$ — Use the point $(1, -1)$.

$y + 1 = -3(x - 1)$ — Simplify.

b. Rewrite the equation in the form $y = mx + b$.

$y + 1 = -3(x - 1)$

$y + 1 = -3x + 3$ — Distributive Property

$y = -3x + 2$ — Subtract 1 from each side.

Write an equation for each line in point-slope form.

7. containing $(4, -1)$ and with a slope of $\frac{1}{2}$ ______________________

8. crossing the x-axis at $x = -3$ and the y-axis at $y = 6$ ______________________

9. containing the points $(-6, -1)$ and $(3, 2)$ ______________________

Rewrite each equation in slope-intercept form.

10. the line from Exercise 7 ______________________

11. the line from Exercise 8 ______________________

12. the line from Exercise 9 ______________________

13. In what situations would you find it easier to use point-slope form, and in what situations would you find it easier to use slope-intercept form? ______________________

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NAME ______________________ CLASS ____________ DATE ____________

Reteaching
5.6 Parallel and Perpendicular Lines

◆ **Skill A** Writing an equation of a line that is parallel to a given line

Recall If two different lines have the same slope, the lines are parallel.
If two different lines are parallel, they have the same slope.
All vertical lines and all horizontal lines are parallel.

◆ **Example**
Write an equation for a line that contains the point (3, 5) and that is parallel to $2x - y = 3$.

◆ **Solution**

Step 1 To find the slope of the given equation, write an equation in the form $y = mx + b$.

$2x - y = 3$
$-y = -2x + 3$ Subtract $2x$ from each side.
$y = 2x + 3$ Multiply each side by -1.

The slope is 2. The slope of a parallel line must also be 2.

Step 2 Use the point-slope form for the equation of a line.

$y - y_1 = m(x - x_1)$
$y - 5 = 2(x - 3)$ Substitute the slope and the point (3, 5) into the equation.

Find the slope of a line that is parallel to the following lines:

1. $y = -\frac{1}{2}x + 1$ ____________
2. $3x + y = 5$ ____________
3. $12 = 2x - 3y$ ____________
4. $x + \frac{1}{4}y = 1$ ____________

Write an equation in point-slope form for each line according to the given information. Show your work.

5. containing $(-1, -4)$ and parallel to $y = 3x + 2$ ____________

6. containing $(2, -4)$ and parallel to $x - 2y = 5$ ____________

7. containing $(-2, 3)$ and parallel to $x = 1$ ____________

8. containing (4, 15) and parallel to $-x + \frac{2}{3}y = 6$ ____________

9. containing $(-1, -6)$ and parallel to $y = -1$ ____________

NAME ______________________________ CLASS ____________ DATE ____________

◆ **Skill B** Writing an equation of a line that is perpendicular to a given line

Recall If the slopes of two lines are m and $-\frac{1}{m}$ and $m \neq 0$, the lines are perpendicular.
If two lines are perpendicular and neither line is vertical or horizontal, the slopes of the lines are m and $-\frac{1}{m}$.
A line perpendicular to a horizontal line is a vertical line with an undefined slope.
A line perpendicular to a vertical line is a horizontal line with a slope of 0.

◆ **Example**
Write an equation for the line that contains $(2, -5)$ and that is perpendicular to the graph of $3x + y = 1$.

◆ **Solution**

Step 1 To find the slope of the given line, write the equation in the form $y = mx + b$.

$$3x + y = 1$$
$$y = -3x + 1$$

The slope is -3, so a line perpendicular to the given line has a slope of $\frac{1}{3}$.

Step 2 Use the point-slope form for the equation of a line.

$$y - y_1 = m(x - x_1)$$
$$y - (-5) = \frac{1}{3}(x - 2) \qquad \text{Substitute the slope and the point } (2, -5).$$
$$y + 5 = \frac{1}{3}(x - 2)$$

Find the slope of a line that is perpendicular to the following lines. If the slope of the desired line is undefined, write *undefined*.

10. $y = 2x - 3$ ____________ **11.** $\frac{1}{3}x - y = 1$ ____________

12. $12 = 3x + 4y$ ____________ **13.** $3x + 6y = 15$ ____________

14. $y = -4$ ____________ **15.** $x = \frac{1}{3}$ ____________

Write an equation in point-slope form for each line according to the given information.

16. containing $(2, 3)$ and perpendicular to $y = 2x - 1$ ____________

17. containing $(1, -3)$ and perpendicular to $y = -3$ ____________

18. containing $(3, 4)$ and perpendicular to $2x - 3y = -6$ ____________

19. containing $(4, 1)$ and perpendicular to $\frac{1}{2}x + y = 3$ ____________

20. containing $(-1, 6)$ and perpendicular to $x = -1$ ____________